

**TENTATIVE GUIDELINES
FOR
THE USE OF LOW GRADE AGGREGATES
AND SOIL AGGREGATE MIXTURES
IN ROAD PAVEMENT CONSTRUCTION**



THE INDIAN ROADS CONGRESS

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1. INTRODUCTION

1.1. Hard aggregates are not available in some parts of the country. In some areas, these are costly and not available within economical leads. Under these circumstances, use of locally available low-grade aggregates assumes great importance. At present, the engineer often looks for hard aggregates even if the cost is high. The main handicap in the use of low-grade aggregates was that there was no guidance available in this respect. Keeping this aspect in view, the Soil Engineering Committee (personnel given below) in their meeting held at Gandhinagar on the 29th November 1972 prepared these tentative guidelines for the use of low-grade aggregates.

| | | |
|--|-------------------|-------------------------|
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The draft guidelines were processed by the Specifications and Standards Committee in their meeting held on 31st January and 1st February 1974 and later approved by the Executive Committee and the Council in their meetings held on the 22nd December 1975 and 3rd January 1976.

2. SCOPE

2.1. Low grade aggregates are those aggregates which lose strength generally by more than 15 per cent upon wetting, when measured in terms of their Aggregate Impact Value. Low-grade aggregates can be used as such if their Wet Aggregate Impact Value does not exceed 50 per cent. If the Wet Aggregate Impact Value exceeds 50 per cent, they would require to be suitably processed before being used. This could be achieved either through stabilisation, say in accordance with IRC: 28-1967 "Tentative Specification for the Construction of Stabilized Soil Roads with Soft Aggregate in Areas of Moderate and High Rainfall" or using the aggregates in a soil-aggregate mixture as discussed in para 6.

2.2. Since one of the significant characteristics of most types of low grade aggregates is loss of mechanical strength upon wetting, the testing of such aggregates should invariably be done in the soaked condition, as per IS: 5640-1970, "Method of Test for Determining Aggregate Impact Value of Soft Coarse Aggregates". In addition to this, it is advisable to run dry Aggregate Impact Value tests occasionally (vide IS: 2386 Part IV)-1963 to get an idea about the comparative performance of the concerned aggregates.

3. COMMON TYPES OF LOW GRADE AGGREGATES

3.1. Some of the common types of low grade aggregates that are normally encountered in India are mentioned in Table 1. It should be noted that the aggregates can sometimes be of a very variable quality, for instance Dhandla. As such mere nomenclature should not be the guide for selection of aggregates but their actual physical characteristics.

TABLE 1. LOW GRADE AGGREGATES

- (i) Laterite
- (ii) Kankar
- (iii) Shale
- (iv) Moorum
- (v) Soft Gravel
- (vi) Dhandla
- (vii) Brick Aggregate
- (viii) Soft Stone

4. TESTING OF LOW GRADE AGGREGATES AND SOIL-AGGREGATE MIXTURES

4.1. Some of the tests considered appropriate for evaluating the suitability of low grade aggregates and of soil-aggregate mixtures, for use in pavement construction, are indicated in Tables 2 and 3.

TABLE 2. TESTING OF LOW GRADE AGGREGATES

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- (i) Aggregate Impact Value Test (wet/dry as mentioned in Clause I)—IS:5640-1970/IS:2386 (Part IV)-1963.
 - (ii) Sodium sulphate soundness test (This test need be conducted only if the aggregates are to be used in a sulphate-infested area)—IS:2386 (Part V)-1963.
 - (iii) CBR on samples soaked for 4 days (only in the case of moorum or soil-aggregate admixtures)—IS:2720 (Part XVI)-1965.
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TABLE 3. TESTING OF SOIL AGGREGATE MIXTURES

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- (i) Gradation test—IS:2720 (Part IV)-1965
 - (ii) Liquid limit and plasticity index of soil fraction—IS:2720 (Part V)-1970
 - (iii) CBR on samples soaked for 4 days (wherever applicable)—IS:2720 (Part XVI)-1965.
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5. CRITERIA FOR USE OF LOW GRADE AGGREGATES

5.1. Physical Requirements

5.1.1. Low grade aggregates can be used for sub-base or base courses of road pavements, or even sometimes as surfacing. For application in individual cases, the suitability of aggregates, except for materials like moorum, should be based on the Wet Aggregate Impact Value. Recommended limits in this regard are set forth in Table 4.

TABLE 4. PHYSICAL REQUIREMENTS OF LOW GRADE AGGREGATES

| Sl. No. | Type of Construction | Test* | Test Method | Requirement |
|---------|---------------------------------------|----------------------------|--------------|-------------|
| 1. | Sub-base | Wet Aggregate Impact Value | IS:5640-1970 | Max. 50% |
| 2. | Base course with bituminous surfacing | —do— | —do— | Max. 40% |
| 3. | Surfacing course | —do— | —do— | Max. 30% |

5.1.2. In the case of materials like moorum, suitability for use in pavement courses should be judged on the basis of soaked CBR values. Whether moorum is used as sub-base for high class roads, or as a surfacing for lightly trafficked roads, the soaked CBR value should not be less than 20. Where this requirement is not satisfied, or a still higher strength is desired, this could be achieved through cement or lime stabilisation in accordance with IRC:50-1973 and IRC : 51-1973 respectively.

5.2. Gradation

5.2.1. Low grade aggregates should be reasonably well graded so as to achieve a dense and well interlocked mass. Recommended gradings for aggregates to be used in Water Bound Macadam construction are given in IRC : 19-1972. For low grade aggregates, these gradings should be taken by way of guidance only since such aggregates are generally of a crushable nature.

6. CRITERIA FOR USE OF SOIL-AGGREGATE MIXTURES

6.1. Soil-aggregate mixtures may be in the form of naturally occurring materials like soil-gravel, or soil purposely blended with suitable aggregate fractions. The primary criteria for acceptability of such materials are plasticity index and gradation. Plasticity index of the material should be less than 6 when used as sub-base or base course with bituminous surfacing and between 6 and 9 when used as a surfacing for lightly trafficked roads. Criteria for gradation should be as set forth in para 6.2.

6.2. The material should be smoothly graded for achieving the maximum possible dry density. Fuller's grading rule** could be used as a guide to work out the optimum grading in different cases. A few typical gradings are given in Table 5 for general application. The first three gradings indicated in Table 5 are especially suited for base courses whereas the remaining two are suitable both for base course and for surfacing.

Note : *Samples for tests should be representative of the materials to be used and collected in accordance with the procedure set forth in IS:2430-1969.

**Fuller's grading rule is given by per cent passing

$$\text{sieve} = 100 \left[\frac{\text{aperture size of sieve}}{\text{size of the largest particle}} \right]^{\frac{1}{2}}$$

TABLE 5. TYPICAL GRADING LIMITS FOR SOIL-AGGREGATES MIXTURES

| Sieve designation (IS:460-1962) | Nominal Maximum size of material | | | | |
|------------------------------------|--------------------------------------|--------|--------|--------|--------|
| | 80 mm | 40 mm | 20 mm | 10 mm | 5 mm |
| | Per cent by weight passing the sieve | | | | |
| 80 mm | 100 | | | | |
| 40 mm | 80-100 | 100 | | | |
| 20 mm | 60-80 | 80-100 | 100 | | |
| 10 mm | 45-65 | 55-80 | 80-100 | 100 | |
| 4.75 mm | 30-50 | 40-60 | 50-75 | 80-100 | 100 |
| 2.36 mm | — | 30-50 | 35-60 | 50-80 | 80-100 |
| 1.18 mm | — | — | — | 40-65 | 50-80 |
| 600 micron | 10-30 | 15-30 | 15-35 | — | 30-60 |
| 300 micron | — | — | — | 20-40 | 20-45 |
| 75 micron | 5-15 | 5-15 | 5-15 | 10-25 | 10-25 |

Note : Not less than 10 per cent should be retained between each pair of successive sieves specified for use except for the larger pair.

6.3. Apart from PI value and gradation, soil-aggregate mixtures may also be evaluated on the basis of soaked CBR value determined in accordance with IS: 2720 (Part XVI)-1965. Where this approach is followed, CBR should desirably be not less than 20 for use as a sub-base. In the case of base courses, the acceptable value of CBR for heavily trafficked routes is normally 80, but a somewhat lower value could be permitted for arid areas, or light volume roads depending on the discretion of the Engineer-in-charge.

7. PAVEMENT DESIGN

7.1. Thickness of flexible pavements using low grade aggregates or soil-aggregate mixtures should be designed in the normal way in accordance with IRC : 37-1970 "Guidelines for the Design of Flexible Pavements". Minimum thickness of any such courses

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should be 10-15 cm, except in the case of moorum, when it should be 15 cm.

7.2. For use as sub-base under rigid pavements, guidance can be had from IRC : 58-1974, "Guidelines for the Design of Rigid Pavements for Highways".

7.3. Whenever low-grade aggregates are used as a sub-base/base course, these should be laid preferably on a well compacted subgrade. Also the road should be kept well drained.
